



Fergusson College (Autonomous), Pune

Learning Outcomes-Based Curriculum
for 3 / 4 years B. Sc. / B. Sc. (Honours) Programme
as per guidelines of
NEP-2020
for
F. Y. B. Sc. (Computer Science)

With effect from Academic Year
2023-2024

Programme Outcomes for B. Sc. Programme	
PO1	Disciplinary Knowledge: Demonstrate comprehensive knowledge of the disciplines that form a part of a graduate programme. Execute strong theoretical and practical understanding generated from the specific graduate programme in the area of work.
PO2	Critical Thinking and Problem solving: Exhibit the skills of analysis, inference, interpretation and problem-solving by observing the situation closely and design the solutions.
PO3	Social competence: Display the understanding, behavioural skills needed for successful social adaptation, work in groups, exhibits thoughts and ideas effectively in writing and orally.
PO4	Research-related skills and Scientific temper: Develop the working knowledge and applications of instrumentation and laboratory techniques. Able to apply skills to design and conduct independent experiments, interpret, establish hypothesis and inquisitiveness towards research.
PO5	Trans-disciplinary knowledge: Integrate different disciplines to uplift the domains of cognitive abilities and transcend beyond discipline-specific approaches to address a common problem.
PO6	Personal and professional competence: Performing dependently and also collaboratively as a part of team to meet defined objectives and carry out work across interdisciplinary fields. Execute interpersonal relationships, self-motivation and adaptability skills and commit to professional ethics.
PO7	Effective Citizenship and Ethics: Demonstrate empathetic social concern and equity centered national development, and ability to act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.
PO8	Environment and Sustainability: Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.
PO9	Self-directed and Life-long learning: Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

PSO No.	Program Specific Outcomes (PSOs) Upon completion of this programme the student will be able to
PSO1	Academic Competence: (i) Understand various concepts of Computing, Statistics, Mathematics and Electronics appropriately to the discipline. (ii) Recommend computing solutions to solve the problems in different domains
PSO2	Personal and Professional Competence: (i) Apply the fundamental knowledge for professional software development as well as to acquire new skills. (ii) Develop strong problem solving, analysing and decision-making abilities. Identify the information and apply their disciplinary knowledge and professional skills to design components , system or processes to meet required specification
PSO3	Research Competence: (i) Apply programming languages, tools and techniques to conduct research and demonstrate appropriate emerging skills to seek solutions to problems in various interdisciplinary fields. (ii) Integrate Computer Science, Electronics, Mathematical and Statistical knowledge to explore different domains' data for experimental and research purpose
PSO4	Entrepreneurial and Social Competence: (i) Use the knowledge and skills necessary to support their career in software development, web development, databases and entrepreneurship in recent trends like data analytics, artificial intelligence, Image processing, Networking, Embedded systems etc. (ii) Develop software based solutions for industry as well as research and development and develop skills required for social interaction.

Fergusson College (Autonomous), Pune
Proposed First Year Curriculum as per NEP 2020
Department of Computer Science

Structure for Major / Minor

Semester	Paper Code	Paper Title	Type	Credits
I	CSC-100 (Major)	Practical on C programming	Practical	2
	CSC-101 (Major)	Problem Solving Principles Using C	Theory	4
	CSC-120 (GE/OE)	IT Literacy	Theory	2
	CSC-121 (GE/OE)	Basics of Linux	Theory	2
	CSC-130 (VSC)	Introduction to Web Technology	Voc. Skill	2
	CSC-140 (SEC)	Basics of Databases	Skill	2
	IKS-101 (IKS)	Indian Knowledge Systems	IKS	2
II	CSC-150 (Major)	Practical on SQL/PLSQL	Practical	2
	CSC-151 (Major)	Relational Database Management System	Theory	4
	CSC-161 (Minor)	Basics of Data Analytics	Theory	2
	MTS-165 (Minor)	Mathematical Foundation for Computer Science	Theory	2
	MTS-166 (Minor)	Mathematical Foundation for Data Science	Theory	2
	ELS-165 (Minor)	Basic Digital Electronics	Theory	2
	STS-165 (Minor)	Fundamentals of Probability Theory	Theory	2
	CSC-170 (GE/OE)	Data Handling using Excel	Theory	2
	CSC-171 (GE/OE)	Web Page Designing	Theory	2
	CSC-180 (VSC)	Basics of Scripting	Theory	2
	CSC-190 (SEC)	Advance C Concepts	Voc. Skill	2

Teaching and Evaluation (Only for FORMAL education courses)

Course Credits	No. of Hours per Semester Theory/Practical	No. of Hours per Week Theory/Practical	Maximum Marks	CE 40 %	ESE 60%
1	15 / 30	1 / 2	25	10	15
2	30 / 60	2 / 4	50	20	30
3	45 / 90	3 / 6	75	30	45
4	60 / 120	4 / 8	100	40	60

Eligibility: As per the rules and regulations of Savitribai Phule Pune University (SPPU)

F. Y. B. Sc. (Computer Science) - Semester I		
CSC-100	Practical on C Programming (Major-Practical)	Credits : 02 Hours : 60
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Define algorithms and flowcharts for given problems in C programming.	
CO2	Illustrate the use of simple data types, operators and control structures in C programming.	
CO3	Implement various standard library and execute the dynamic memory management techniques using the concept of pointers	
CO4	Divide the programs into separate modules by writing user defined functions	
CO5	Evaluate the programs to test and validate the output	
CO6	Design and write programs to implement the concepts of functions, arrays, pointers and strings in C programming	

Sr. No.	Title of Experiment / Practical
1.	Defining algorithms and flowcharts for a given problem statements
2.	Use of data types, simple operators
3.	Decision making statements (if-else and switch case)
4.	Use of loops
5.	Use of Nested Loops
6.	Menu driven programs using Standard Library Functions
7.	Use of User Defined Functions
8.	Recursive functions
9.	Use of Arrays
10.	Use of pointers
11.	Concept of strings, array of strings and String operations using pointers
12.	Case Study

F.Y B.Sc (Computer Science) – Semester I		
CSC-101	Problem Solving Principles using C (Major- Theory)	Credits: 04 Hours : 60
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Identify and define appropriate solutions to problems in the field of computer science and other related disciplinary areas.	
CO2	Illustrate the solutions to the problems in the form of simple algorithms and flowcharts	
CO3	Apply various computer programming language concepts and strategies to write and execute efficient and structured computer programs	
CO4	Analyze and compile the programs to detect any errors, debug and correct the programs.	
CO5	Test and perform critical evaluation of the program outcome to validate the program logic.	
CO6	Integrate the concepts of control structures, functions, arrays, pointers and strings to create more complex programming solutions	

Unit	Contents	No. of Hours
I	Problem Solving Principles 1.1 What is Problem Solving? 1.2 Problem solving using computer 1.3 Algorithm 1.4 Flowchart	04
II	Introduction to Programming Languages 2.1 Computer Software and Classification 2.2 Computer Languages: Machine Language, Assembly Language, High-Level Language 2.3 Compiler and Interpreter	02
III	Overview of C 3.1 History of C 3.2 Features of C 3.3 Structure of a C Program 3.4 C Program Development Lifecycle 3.5 First C Program 3.6 Applications of C	03
IV	Fundamentals of C 4.1 Character Set in C 4.2 C Tokens 4.3 Keywords, Identifiers, Variables 4.4 Constants: Integer, Character, Float 4.5 Datatypes 4.6 Operators, Precedence and Associativity of Operators 4.7 Input and Output operations 4.8 Escape Sequences	10
V	Decision Making: Branching and Looping 5.1 Introduction to Decision Making 5.2 Branching Statements	12

	5.3 Simple if statement a. if..else statement b. nested if..else c. else..if ladder d. switch-case 5.4 Conditional operator 5.5 Looping Statements 5.6 while statement 5.7 do..while statement 5.8 for loop 5.9 Nested loops 5.10 Jump Statements: break, continue, goto, exit()	
VI	Functions 6.1 What is function? 6.2 Advantages of functions 6.3 Standard Library Functions 6.4 User-defined functions: Declaration, Definition, Function call, parameter 6.5 Passing 6.6 return statement 6.7 Scope of variables 6.8 Storage Classes 6.9 Recursion	10
VII	Arrays 7.1 What is an array? 7.2 Types of array: One Dimensional, Two-Dimensional, Multi- Dimensional 7.3 Array declaration, initialization, accessing array elements 7.4 Passing array to function	07
VIII	Pointers 8.1 Pointer declaration, initialization, Dereferencing pointers, Pointer arithmetic 8.2 Pointer to pointer, Arrays and pointers, Array of Pointers 8.3 Functions and pointers – passing pointers to functions, function returning pointers 8.4 Dynamic memory allocation	07
IX	Strings 9.1 Declaration and initialization 9.2 String input/output, format specifiers 9.3 Standard library functions 9.4 Strings and pointers, Array of strings 9.5 Command Line Arguments	05

Learning Resources:

1. Behrouz A. Forouzan and Richard F. Gilberg: Computer Science: A Structured Programming Approach using C Third Edition, Thomson Course Technology publication
2. Brian W. Kernighan and Dennis M. Ritchie: The C Programming Language, Second Edition, Prentice Hall Publication
3. Byron S Gottfried, Schaum's Outlines Programming With C, Second Edition, Tata McGraw Hill
4. Yashavant Kanetkar: Let Us C, Seventh Edition, PBP Publications
5. E Balagurusamy: Programming in ANSI C, Fourth Edition, TMH

F.Y B.Sc (Computer Science) – Semester I		
CSC-120	IT Literacy (GE/OE-Theory)	Credits: 02 Hours: 30
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Identify and define appropriate solutions to problems in the field of computer Basic and Software knowledge.	
CO2	Apply various office tools and strategies to write and execute efficient and structured office work	
CO3	Integrate the general knowledge by using Internet to get the solutions about office work and others	
CO4	Updated knowledge of Internet with accessing various tools of emails.	
CO5	Apply and practically demonstrate the office file handling its management.	
CO6	Developed the strong ability and execute the collaborative work using google drive.	
Unit	Contents	No. of Hours
I	Computer Basics 1.1 Introduction to computer 1.2 Characteristics of computer 1.3 Computer generations 1.4 Basic operation of computer 1.5 Block diagram of Computer 1.6 Computer software	06
II	Office tools 2.1 Introduction 2.2 Objective 2.3 Word Processing Basics 2.4 Opening Word Processing Package 2.5 Title Bar, Menu Bar, Toolbars & Sidebar 2.6 Creating a New Document 2.7 Opening and Closing Documents 2.8 Save and Save As, Print Document 2.9 Using The Help 2.10 Page Setup, Print Preview, Printing of Documents, PDF file and Saving a Document as PDF file 2.11 Document manipulation & Formatting, Text Selection, Cut, Copy and Paste, Font, Color, Style and Size selection, Alignment of Text, Undo & Redo, Spelling & Grammar, Shortcut Keys	06
III	Basics of Internet 3.1 Introduction, Objectives 3.2 Internet & WWW 3.3 Website Address and URL 3.4 Applications of Internet 3.5 Modes of Connecting Internet (Hotspot, Wi-Fi, LAN Cable, Broadband, USB Tethering) 3.6 Popular Web Browsers (Internet Explorer/Edge, Chrome, Mozilla Firefox etc)	06

	3.7 Exploring the Internet	
IV	e-mail 4.1 Introduction to Gmail Window 4.2 How to add contacts (E-Mail)/Edit contacts 4.3 Details of Compose dialog box fields- To, CC, BCC, Subject etc., Compose an e-mail, add attachment and add signature, How to add more than one recipients at a time (from excel file)+Comma, Separated list(notepad) 4.4 E-mail Formatting 4.5 How to send Reply/Forward the mail 4.6 Email Settings: download (set directory/drive other than C drive), signature etc. Inbox: all options 4.7 Managing E-mail	06
V	Collaborative work using Drive 5.1 Folder(Creating new Folder) 5.2 File Upload, Folder Upload, 5.3 Creating, sharing and collaborative working with : Google Sheet and Google Doc, Google Form	06

Learning Resources:

1. MSCIT Books
2. CDAC DIT books
3. Office 365 days books

e- Resources:

1. www.microsoft.com
2. www.ntpl
3. www.swayam.com

F.Y B.Sc (Computer Science) – Semester I		
CSC-121	Basics of Linux (GE/OE-Theory)	Credits : 02 Hours: 30
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Identify the Unix Operating system.	
CO2	Discuss the concepts of vi editor and basic Linux commands.	
CO3	Apply the knowledge of Linux commands in Cent OS or any unix operating system.	
CO4	Integrate the concepts of Linux installation.	
CO5	Test the commands to detect the users.	
CO6	Develop the strong ability to use the Linux commands.	

Unit	Contents	No. of Hours
I	Overview of Unix and Linux Operating System 1.1 Introduction 1.2 History of Linux 1.3 Features of Linux 1.4 Linux Architecture 1.5 What is Linux 1.6 Log in, Log out, Change password	04
II	Basics about Linux installation 2.1 System configuration 2.2 Configure and manage local storage 2.3 Create and configure file systems 2.4 Mounting external device 2.5 Setting folder and file permissions	06
III	Working with Basic Linux Commands 3.1 Vi editor – command mode, insert mode, replace mode 3.2 deleting character or line 3.3 copying line, replacing characters 3.4 searching particular line, line number 3.5 save or abort the file in vi 3.6 Commands such as date, mkdir, chdir, cd, rmdir, cat	10
IV	Shell Interface and commands at shell prompt 4.1 cp, mv, rm, pwd, wc, grep, ypasswd, cal, clear utility 4.2 File creation at prompt 4.3 appending file at prompt 4.4 overwriting the contents of file	10

Learning Resources:

1. Daniel J. Barrett, Linux Pocket Guide: Essential Commands, "O'Reilly Media, Inc.", 2016
2. Wale Soyinka, Linux Administration: A Beginner's Guide - 7th Edition
3. Jason Cannon, Linux Administration, CreateSpace Independent Publishing Platform

4. William Shotts, The Linux Command Line
5. Stephen Figgins, Linux in a Nutshell: A Desktop Quick Reference

F.Y B.Sc (Computer Science) – Semester I		
CSC-130	Introduction to Web Technology (VSC)	Credits : 02 Hours: 30
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Describe different web technologies and application development issues and trends	
CO2	Develop the skill & knowledge of Web page design.	
CO3	Apply CSS types for different web pages.	
CO4	Explain different components and technologies of World Wide Web as a platform.	
CO5	Design websites using several front end web technologies	
CO6	Compare various web technologies.	

Unit	Contents	No. of Hours
I	Overview: 1.1 Introduction to web technology? What is Web Development? 1.2 Introduction to Web server, web browser, Web Protocols (HTTP, TCP/IP Model, UDP, FTP, SMTP, SOAP) 1.3 Web development: Frontend, backend 1.4 Front End Frameworks and Libraries: HTML, CSS, Javascript 1.5 Back End Frameworks and Technology: PHP, Node JS, Python, Ruby, Java, JavaScript, DBMS	03
II	Introduction to HTML: 2.1 HTML features 2.2 Structure 2.3 HTML Tags 2.4 Commenting Codes 2.5 Formatting and Fonts 2.6 Anchors, Hyperlinks 2.7 Backgrounds 2.8 HTML Lists, Tables Frames 2.9 HTML Forms 2.10 HTML Graphics 2.11 HTML SVG-Basics 2.12 HTML Canvas Basics	15
III	Introduction to CSS: 3.1 Need for CSS 3.2 Introduction to CSS 3.3 Basic Syntax and structure 3.4 Inline styles 3.5 Embedding Style sheets	12

	3.6 Linking External Style 3.7 Backgrounds 3.8 Manipulating Text 3.9 Margins and Padding 3.10 Positioning using CSS	
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Learning Resources:

1. DT Editorial Services, “HTML 5 Black Book”, Dreamtech Press, 2010 3.
2. Kogent Learning Solutions Inc., “Web Technologies, Black Book”, Dreamtech Press, 2009
3. P.J. Deitel & H.M. Deitel, “Internet & World Wide Web How to Program (4th Edition)”, Pearson –Prentice Hall, 2000

F.Y B.Sc (Computer Science) – Semester I		
CSC -140	Basics of Databases (SEC)	Credits : 02 Hours: 30
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Identify the databases and relationships between them by analyzing the information.	
CO2	Discuss database concepts, applications, and data models in the field of computer science along with other areas and develop the design of databases.	
CO3	Apply the knowledge of database concepts with normalization to write and execute the queries and operations in SQL.	
CO4	Integrate the concepts of queries, joins, and aggregate functions in SQL.	
CO5	Test the queries and operations to detect the errors.	
CO6	Develop the strong ability to use the database concepts for writing queries and Operations in SQL.	

Unit	Contents	No. of Hours
I	Introduction to DBMS 1.1 Introduction 1.2 Basic Concepts and Definition: Data, Information, Data versus Information, Data Warehouse, Metadata, Data Item or Field, Records, Data Dictionary, Database, Database System 1.3 Database Users and Database Administrator, Functions and Responsibilities of DBA 1.4 File System versus Database System 1.5 View of Data 1.6 Database Languages 1.7 Schemas, Sub-schemas and Instance 1.8 3-Level Architecture: Internal Level, Conceptual Level, External Level 1.9 Data Independence: Physical Data Independence, Logical Data Independence 1.10 Structure of a DBMS 1.11 Functions of DBMS	10

	1.12 Data Models	
II	Database design and ER Model: 2.1 Overview 2.2 ER – Model 2.3 Constraints 2.4 E-R Diagrams, ERD Issues, Weak Entity Sets 2.5 Codd’s Rules 2.6 Relational database model: Logical view of data, keys, integrity rules 2.7 Relational Database design: Features of good relational database design 2.8 Atomic domain and Normalization 1NF, 2NF, 3NF, BCNF	10
III	Relational algebra: 3.1 Introduction 3.2 Basic operations: Selection and projection, set operations, renaming, Joins, Division	06
IV	Other Databases 4.1 Introduction to Parallel and distributed Databases 4.2 Centralized Database 4.3 Introduction to Object Based Databases: NoSQL Database, Big Data Databases	04

Learning Resources:

1. Henry F. Korth, Abraham Silberschatz, S. Sudarshan Database System Concepts, Tata McGraw-Hill Education
2. Elmasri and Navathe, Fundamentals of Database Systems, 4th Edition
3. S. K. Singh, Database Management System: Concepts, design & applications, Pearson publication
4. NoSQL Distilled, Pramod J. Sadalage and Martin Fowler, Addison Wesley
5. NoSQL Distilled A Brief Guide to the Emerging World of Polyglot Persistence: by Pramod J. Sadalage, Martin Fowler, Addison-Wesley, Pearson Education, Inc.
6. MongoDB: The Definitive Guide, Kristina Chodorow, Michael Dirolf, O’Reilly Publications

F.Y B.Sc (Computer Science) – Semester I		
IKS-101	Indian Knowledge Systems (IKS)	Credits: 2 Hours: 30
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Recall the basic concepts of Indian Knowledge System (IKS)	
CO2	Articulate the foundation of IKS and explain historical and cultural context of Indian knowledge systems	
CO3	Use the knowledge of IKS to understand discipline specific case studies.	
CO4	Develop critical thinking and problem-solving skills in the context of Indian knowledge systems.	

Unit	Contents	No. of hours
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I	Overview of IKS 1.1 Survey of IKS Domains: A broad overview of disciplines included in the IKS and historical developments. 1.2 Sources of IKS knowledge, classification of IKS texts, a survey of available primary texts, translated primary texts, and secondary resource materials. Differences between a sutra, bhashya, karika, and vartika texts. Fourteen/eighteen vidyasthanas, tantrayukti 1.3 Vocabulary of IKS: Introduction to Panchamahabhutas, concept of a sutra, introduction to the concepts of non-translatables (Ex. dharma, punya, aatma, karma, yagna, shakti, varna, jaati, moksha, loka, daana, itihaasa, puraana etc.) and importance of using the proper terminology. Terms such as praja, janata, loktantra, prajatantra, ganatantra, swariva, surajya, rashtra, desh. 1.4 Philosophical foundations of IKS: Introduction to Samkhya, vaisheshika and Nyaya. 1.5 Methods in IKS: Introduction to the concept of building and testing hypothesis using the methods of tantrayukti. Introduction to pramanas and their validity, upapatti; Standards of argumentation in the vada traditions (introduction to concepts of vaada, samvaada, vivaada, jalpa, vitanda). Concept of poorvapaksha, uttarapaksha.	15
II	Case Studies (Few of these may be selected as appropriate) 2.1 Mathematics of Madhava, Nilakantha Somayaji 2.2 Astronomical models of Aryabhata 2.3 Wootz steel, Aranumula Mirrors, and lost wax process for bronze castings 2.4 Foundational aspects of Ayurveda 2.5 Foundational aspects of Ashtanga yoga 2.6 Foundational aspects of Sangeeta and Natva Shastra 2.7 Discipline Specific Case Study	10
III	India and the World: 3.1 Influence of IKS on the world, knowledge exchanges with other classical civilizations. and inter-civilizational exchanges	05

Learning Resources:

1. An Introduction to Indian Knowledge Systems: Concepts and Applications, B Mahadevan, V R Bhat, and Nagendra Pavana R N; 2022 (Prentice Hall of India).
2. Indian Knowledge Systems: Vol I and II, Kapil Kapoor and A K Singh; 2005 (D.K. Print World Ltd).
3. The Beautiful Tree: Indigenous India Education in the Eighteenth Century. Dharampal, Biblia Impex, New Delhi, 1983. Reprinted by Keerthi Publishing House Pvt Ltd. Combatore, 1995.
4. Indian Science and Technology in the Eighteenth Century, Dharampal. Delhi: Impex India, 1971. The British Journal for the History of Science.
5. The Wonder That Was India, Arthur Llewellyn Basham, 1954, Sidgwick & Jackson.
6. The India they saw series (foreigner visitors on India in history from 5CE to 17th century), Ed. Meenakshi Jain and Sandhya Jain, Prabhat Prakashan

SEMESTER – II

F.Y B.Sc (Computer Science) – Semester II		
CSC-150	Practical on SQL/PLSQL (Major- Practical)	Credits : 02 Hours: 60
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Define different keys and understand there concepts	
CO2	Illustrate the concept of table level and column level constraints	
CO3	Implement different types of queries and aggregate functions	
CO4	Analyze insert, update, delete records and learn Data Manipulation Language	
CO5	Validate the queries by implementing error and exception handling techniques	
CO6	Design and write cursors, triggers, views for different databases	

Sr. No.	Title of Experiment / Practical
1.	Using basic Linux commands and VI Editor
2.	Create table, Primary key, Referential integrity, and PK constraints
3.	Constraints, Alter Table
4.	Insert, Delete and Update Statement.
5.	To Query the tables using aggregate functions.
6.	Nested Queries
7.	Control Structures
8.	Stored Functions
9.	Exception Handling
10.	Views
11.	Cursors
12.	Triggers

Major Course – 2 (Theory)

F.Y B.Sc (Computer Science) – Semester II		
CSC-151	Relational Database Management System (Major-Theory)	Credits : 04 Hours: 60
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Outline the fundamental concepts of relational database management systems.	
CO2	Explain various methods of database security and access control techniques.	
CO3	Illustrate the transaction management and recovery management techniques adopted in relational database management systems.	
CO4	Differentiate between various types of databases.	
CO5	Validate the queries by implementing error and exception handling techniques.	
CO6	Write queries, functions, triggers, cursors and views using PL/SQL.	

Unit	Contents	No. of Hours
I	Structured Query Language (MySQL) 1.1 Introduction 1.2 Basic operations 1.3 Set operations 1.4 Aggregate functions 1.5 Null values 1.6 Nested Sub-queries 1.7 Modifications to Database, DDL commands with examples 1.8 SQL mechanisms for joining relations (inner joins, outer joins and their types) 1.9 Examples on SQL (case studies)	12
II	Relational Database Design 2.1 Procedural Language: Data types, Language structure 2.2 Controlling the program flow, conditional statements, Loops 2.3 Views 2.4 Stored Functions, Stored Procedures 2.5 Handling errors and exceptions 2.6 Cursors 2.7 Concepts of Triggers	18

III	Transaction Concepts and concurrency control 3.1 Describe a transaction 3.2 properties of transaction 3.3 State of the transaction 3.4 Executing transactions concurrently associated problem in concurrent execution 3.5 Schedules, types of schedules 3.6 Concept of Serializability, precedence graph for Serializability, Ensuring serializability by locks 3.7 Different lock modes, 2PL and its variations 3.8 Basic timestamp method for concurrency, Thomas Write Rule, Locks with multiple granularity, dynamic database concurrency (Phantom Problem), Timestamps versus locking 3.9 Deadlock handling methods, Detection and Recovery(Wait for graph), Prevention algorithms (Wound-wait, Wait-die)	12
IV	Database Integrity and Security Concepts 4.1 Domain constraints, Referential Integrity 4.2 Introduction to database security concepts, Methods for database security, Discretionary access control method, Mandatory access control, Role based access control for multilevel security 4.3 Use of views in security enforcement 4.4 Overview of encryption technique for security 4.5 Statistical database security	10
V	Crash Recovery 5.1 Failure classification 5.2 Recovery concepts 5.3 Log base recovery techniques (Deferred and Immediate update), Checkpoints 5.4 Recovery with concurrent transactions (Rollback, checkpoints, commit), Database backup and recovery from catastrophic failure	08

Learning Resources:

1. Henry F. Korth, Abraham Silberschatz, S. Sudarshan Database System Concepts, ISBN:9780071289597, Tata McGraw-Hill Education
2. An Introduction to Database Systems, C J Date, Addison-Wesley
3. Database Systems: Concepts, Design and Application, S.K.Singh, Pearson, Education

F. Y. B. Sc. (Computer Science) - Semester II		
CSC-161	Basics of Data Analytics (Minor-Theory)	Credits: 02 Hours: 30
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Identify the type of and level of data.	
CO2	Understand the role of data analysts, career opportunities, and future of data analytics	
CO3	Apply the tools for analysing data and inferring insights	
CO4	Analyse and handle different types of data and understand data sampling, observation, dataset, prediction, and levels of measurement.	
CO5	Selection of the specific domain for Data analysis	
CO6	Develop skill set to become Data Analyst	

Unit	Contents	No. of Hours
I	Introduction to Data Analytics 1.1 What is data analytics 1.2 Modern Data Ecosystem 1.3 Key Players in the Data Ecosystem 1.4 Need of Data Analytics 1.5 Applications	03
II	Overview of Data Analytics 2.1 Types of data analytics: descriptive, diagnostic, predictive, and prescriptive analytics 2.2 Difference between data analytics and data science	03
III	Dealing with different types of data 3.1 Terminologies in Data Analytics: Observation, Data Sampling, Dataset and prediction 3.2 Types of Data: Structured, Unstructured and semi-structured 3.3 Qualitative and Quantitative Data 3.4 Data Levels of measurement: Nominal, ordinal, Interval and ratio 3.5 Data Warehousing	04
IV	Tools for Data Analytics 4.1 Data Analysis tools: R, Python 4.2 Data Visualization tools: Jupyter, Tableau 4.3 Machine learning tools: Spark, Azure ML studio	10
V	Data Analyst 5.1 Definition 5.2 Role of data analyst 5.3 Process followed by data analyst 5.4 Skill set for data analyst 5.5 Role of Data Analyst in Different Industries: Healthcare,	05

	Finance, Marketing, Environmental Science	
VI	Career opportunities, future and case studies 6.1 Job titles and skills in data analytics (e.g. data scientist, analyst) 6.2 Technology driving future data analytics (e.g. AI, automation) 6.3 Emerging trends in data analytics 6.4 Case Studies	05

Learning Resources:

1. Anil Maheshwari, “Data Analytics Made Accessible”, 2020 Edition

Web contents:

1. www.analyticsvidya.com
2. www.udemy.com
3. <https://towardsdatascience.com/machine-learning/home>

F. Y. B. Sc. (Computer Science) - Semester II		
MTS-165	Mathematics for Computer Science (Minor-Theory)	Credits: 02 Hours: 30
Course Outcomes (COs)		
On completion of the course, the students will be able to:		
CO1	Describe the fundamentals of logic and operands.	
CO2	Discuss concepts of relation and functions .	
CO3	Apply the counting principle on real life situations.	
CO4	Analyze the basic structures of lattice and Boolean algebra.	
CO5	Determine the solutions of recurrence relations.	
CO6	Integrate basic concepts of logic, Recurrence ,Lattices and counting principles.	

Unit No.	Title of Unit and Contents	No. of hours
I	Statements and Logic 1.1 Statements 1.2 Statements with quantifiers 1.3 Compound Statements 1.4 Implications 1.5 Proofs in Mathematics	4
II	Sets, Relations and Functions 2.1 Sets, Operations on Sets, Power Set, Cartesian product of Sets, Graphical representation of sets 2.2 Relations, types of Relations. 2.3 Equivalence relations. 2.4 Partition of a set and equivalence classes. 2.5 Digraphs of relations, matrix representation and composition of Relations.	8

	2.6 Transitive closure and Warshall's Algorithm. 2.7 Types of functions (One – One, Onto, Bijective).	
III	Lattice and Boolean Algebra 3.1 Partial ordering relations 3.2 Poset, Hasse diagram. 3.3 Lattices, Complemented lattice, Bounded lattice and Distributive Lattice. 3.4 Boolean variable, Boolean Function of degree n, Boolean identities, Definition of Boolean Algebra. 3.5 Disjunctive Normal form, Conjunctive Normal form.	7
IV	Counting Principles 4.1 Cardinality of a finite set. 4.2 The Sum Rule, the Product Rule, the Inclusion- Exclusion Principle. 4.3 Statement of Pigeonhole Principle, Its Applications.	3
V	Recurrence Relation 5.1 Introduction to Recurrence Relations, Formation. 5.2 Linear Recurrence Relations with constant coefficients. 5.3 Homogeneous Solutions. 5.4 Particular Solutions. 5.5 Total Solutions.	8

References:

1. Kenneth Rosen, 'Discrete Mathematics and its applications', Seventh Edition by Tata McGraw Hill.
2. Kolman, Busby, Ross, Rehman, 'Discrete Mathematical Structures', Sixth edition, by Prentice Hall.
3. C. L. Liu, 'Elements of Discrete Mathematics', Fourth edition, by Tata McGraw Hill.

MTS-166	Mathematics for Data Science (Minor-Theory)	Credits: 02 Hours: 30
Course Outcomes (COs)		
On completion of the course, the students will be able to:		
CO1	Describe the basic concepts of Matrix operations.	
CO2	Compute chance of an event based on prior knowledge of conditions related to that event.	
CO3	Implement the fundamentals of logic and operands.	
CO4	Analyze Uniqueness and existence of solutions of linear equations.	
CO5	Determine the concepts of various types of Matrices	
CO6	Integrate ideas to find solutions to various system of linear equations.	

Unit No.	Title of Unit and Contents	No. of hours
I	Statements and Logic 1.1 Statements 1.2 Statements with quantifiers 1.3 Compound Statements 1.4 Implications 1.5 Proofs in Mathematics	4
II	Matrices 2.1 Matrix Operations. 2.2 The Inverse of a Matrix. 2.3 Characterization of invertible matrices.	4
III	System of Linear Equations 3.1 System of Linear equations. 3.2 Elementary Row operations and echelon forms. 3.3 Solution set of linear systems. 3.4 Matrix factorization [LU decomposition]	6
IV	Permutation and Combinations 4.1 Cardinality of a finite set. 4.2 The Product Rule, the Sum Rule, the Inclusion- Exclusion Principle. 4.3 Statement of Pigeonhole Principle, Its Applications. 4.4 Introduction to Permutations and Combinations. 4.5 Permutation and Combination with Repetitions.	8
V	Basics of Probability 5.1 Sample space, Discrete sample space: finite and countably infinite. 5.2 Concept of occurrence of an event. Algebra of events. 5.3 Definition of conditional probability of an event. 5.4 Definition of independence of two events. 5.5 Multiplication theorem. 5.6 Application of Bayes' Theorem	8

References:

1. Howard Anton and Chris Rorres, 'Elementary Linear Algebra with Supplemental Applications', eleventh edition, Wiley Student Edition.
2. Kanti Bhushan Datta, 'Matrix and Linear Algebra (aided with MATLAB)', Third Edition, Eastern Economic Edition.
3. S. C. Gupta and V. K. Kapoor, 'Fundamentals of Mathematical Statistics', Eighth Edition, Sultan Chand and Sons Publishers, New Delhi.

F. Y. B. Sc. (Computer Science) - Semester II		
ELS-165	Basic Digital Electronics (Minor-Theory)	Credits: 02 Hours: 30
CO1	Identify logic gates with symbols and truth tables. State De Morgan's theorems.	
CO2	Discuss the working of different logic circuits.	
CO3	Apply the various rules and laws of Boolean Algebra for designing digital circuits.	
CO4	Analyze the arithmetic and logical circuits for specific applications.	
CO5	Evaluate different combinational circuits using logic gates.	
CO6	Construct different digital circuits using K-map.	

Unit	Contents	No. of Hours
I	Logic Gates Introduction to analog signals and digital signals, Positive and Negative logic, Logic gates: definition, symbols, truth tables, Boolean expressions, pulsed operation of NOT, OR, AND, NAND, NOR, EX-OR, EX-NOR gates	3
II	Number System and Codes Decimal, binary, octal, hexadecimal number systems, Conversion of numbers from one number system to another including decimal/binary points, Binary addition, subtraction, multiplication, division, 1's and 2's complement method of subtraction BCD code numbers and their limitations, Concept of parity, Error detection using parity, ASCII code	8
III	Boolean Algebra Rules and laws of Boolean algebra, logic expression, De Morgan's theorems, their proof, Sum of products form (min. terms), Product of sum form (max. terms), Simplification of Boolean expressions using Boolean algebra and Karnaugh map upto 4 variables.	8
IV	Arithmetic and Logical Circuits Half adder, Full adder circuit and its operation, Parallel binary adder, Half Subtractor, and full Subtractor	4
V	Combinational Circuits Multiplexer(2:1 and 4:1), De-multiplexer (1:2 and 1:4), Encoder, Priority encoder, Decoder, BCD to seven segment decoder	7

References:

1. Digital Principals, Schaum's outline series, Tata McGraw Hill (2006)
2. Digital System Design, Morris Mano, Pearson Education (2014)
3. Digital Computer Electronics, Malvino
4. Fundamentals of Logic Design, Charles H. Roth, Jr. and Larry L. Kinney
5. Modern Digital Electronics: Jain R.P., Tata McGraw Hill
6. Digital Principles and Applications: Malvino Leach, Tata McGraw-Hill.
7. Digital Fundamentals: Floyd T.M., Jain R.P., Pearson Education

F. Y. B. Sc. (Computer Science) - Semester II		
STS-165	Fundamentals of Probability Theory (Minor-Theory)	Credits: 02 Hours: 30
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Describe random and non-random experiments.	
CO2	To help make informed judgments based on a pattern of data observed previously.	
CO3	To find chance of an event based on prior knowledge of conditions that might be related to the event.	
CO4	Analyse the statistical measures widely used in medicine and other fields.	
CO5	To enhance the computational techniques related to probability.	
CO6	Develop analytical thinking by using the ability to see a problem or solution from different points of view.	

Unit No.	Title and Contents	No. of Lectures
Unit -I	Counting Principles, Sample spaces and Events 1.1 Counting Principles 1.2 Permutation 1.3 Combination. 1.4 Deterministic and non-deterministic models. 1.5 Random Experiment, Sample Spaces (finite and countably infinite) 1.6 Events: types of events, Operations on events.	4
Unit -II	Basic Theory of Probability 2.1 Probability - classical definition, probability models, axioms of probability, probability of an event. 2.2 Theorems of probability (with proof) i) $0 \leq P(A) \leq 1$ ii) $P(A) + P(A') = 1$ iii) $P(A) \leq P(B)$ when $A \subset B$ iv) $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ 2.3 Numerical problems related to real life situations.	10
Unit –III	Advanced Theory of Probability 3.1 Concepts and definitions of conditional probability, multiplication theorem $P(A \cap B) = P(A) \cdot P(B A)$ 3.2 Bayes' theorem (without proof) 3.3 Concept of Posterior probability, problems on posterior probability. 3.4 Concept and definition of independence of two	10

	events. 3.5 Numerical problems related to real life situations.	
Unit –IV	Sensitivity and Specificity 4.1 Application of Bayes' theorem to design a procedure for false positive and false negative. 4.2 Definition of sensitivity of a procedure, specificity of a procedure. 4.3 Numerical problems related to real life situations.	6

References:

1. Statistical Methods, G.W. Snedecor, W.G. Cochran, John Wiley & sons, 1989.
2. Fundamentals of Applied Statistics (3rd Edition), Gupta and Kapoor, S.Chand and Sons, New Delhi, 1987.
3. Modern Elementary Statistics, Freund J.E., Pearson Publication, 2005.
4. A First course in Probability 6th Edition, Ross, Pearson Publication, 2006.

F.Y B.Sc (Computer Science) – Semester II		
CSC-170	Data Handling using Excel (GE/OE)	Credits: 02 Hours: 30
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Understand and remember basic principles of data	
CO2	Build numerous graphs in Excel	
CO3	Apply analysis techniques to datasheets in Excel	
CO4	Analyze Excel functions and techniques for data analysis	
CO5	Test filters and learn how to use Charts to streamline workflow in Excel	
CO6	Integrate different features of excel to Create effective design principles and present data	

Unit	Contents	No. of Hours
I	Introduction to Excel : 1.1 About Excel & Microsoft 1.2 Uses of Excel, Excel software 1.3 Spreadsheet window pane, Title Bar, Menu Bar, Standard Toolbar, Formatting Toolbar 1.4 The Ribbon, File Tab and Backstage View, Formula Bar, Workbook Window, Status Bar, Task Pane, Workbook & sheet	02
II	Basic Spreadsheet Handling : 2.1 Selecting Columns & Rows 2.2 Changing Column Width & Row Height 2.3 Autofitting Columns & Rows, Hiding/Unhiding Columns & Rows 2.4 Inserting & Deleting Columns & Rows, Cell, Address of a cell, Components of a cell – Format, value, formula 2.5 Use of paste and paste specialcase	02

III	Functions in Excel: 3.1 Text Functions 3.2 Date time Functions 3.3 Logical Functions 3.4 Advanced paste special techniques 3.5 Using Ranges, Selecting Ranges, Entering Information Into a Range 3.6 Using AutoFill	03
IV	Creating Basic and Advanced Formulas: 4.1 Using Formulas 4.2 Formula Functions – Sum, Average, if, Count, max, min, Proper, Upper, Lower 4.3 Using AutoSum, Concatenate 4.4 Vlookup, Hlookup 4.5 Match, Countif, Text, Trim	05
V	Spreadsheet Charts: 5.1 Creating Charts 5.2 Different types of chart 5.3 Formatting Chart Objects 5.4 Changing the Chart Type 5.5 Showing and Hiding the Legend 5.6 Showing and Hiding the Data Table	05
VI	Data Analysis: 6.1 Sorting 6.2 Filter 6.3 Text to Column 6.4 Data Validation	03
VII	PivotTables: 7.1 Creating PivotTables 7.2 Manipulating a PivotTable 7.3 Using the PivotTable Toolbar 7.4 Changing Data Field 7.5 Properties 7.6 Displaying a PivotChart 7.7 Setting PivotTable Options 7.8 Adding Subtotals to PivotTables	05
VIII	Spreadsheet Tools: 8.1 Moving between Spreadsheets 8.2 Selecting Multiple Spreadsheets 8.3 Inserting and Deleting Spreadsheets Renaming Spreadsheets 8.4 Splitting the Screen, Freezing Panes 8.5 Copying and Pasting Data between Spreadsheets 8.6 Hiding, Protecting worksheets	03
IX	Making Macros: 9.1 Recording Macros 9.2 Running Macros 9.3 Deleting Macros	02

Learning Resources:

1. <https://www.simplilearn.com/tutorials/excel-tutorial/data-analysis-excel>
2. <https://www.futurelearn.com/courses/a-beginners-guide-to-data-handling-and-management-in-excel>
3. <https://support.microsoft.com/en-us/office/analyze-data-in-excel>
4. <https://www.analyticsvidhya.com/blog/2021/11/a-comprehensive-guide-on-microsoft-excel-for-data-analysis/>

F.Y B.Sc (Computer Science) – Semester II		
CSC -171	Web Page Designing (GE/OE)	Credits : 02 Hours : 30
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Describe different web technologies and application development issues and trends	
CO2	Develop the skill & knowledge of Web page design	
CO3	Apply CSS styles to web page	
CO4	Explain different components and technologies of World Wide Web as a platform.	
CO5	Design websites using several front end web technologies	
CO6	Compare various web technologies	

Unit	Contents	No. of Hours
I	Overview: 1.1 Introduction to web technology? What is Web Development? 1.2 Introduction to Web server, web browser, Web Protocols (HTTP, TCP/IP Model, UDP, FTP, SMTP, SOAP) 1.3 Web development: Frontend, backend 1.4 Front End Frameworks and Libraries: HTML, CSS, Javascript 1.5 Back End Frameworks and Technology: PHP, Node JS, Python, Ruby, Java, JavaScript, DBMS	04
II	Introduction to HTML: 2.1 HTML features 2.2 Structure 2.3 HTML Tags 2.4 Commenting Codes 2.5 Formatting and Fonts 2.6 Anchors, Hyperlinks 2.7 Backgrounds 2.8 HTML Lists, Tables Frames 2.9 HTML Forms 2.10 HTML Graphics 2.11 HTML SVG-Basics 2.12 HTML Canvas Basics	14

III	Introduction to CSS: 3.1 Need for CSS 3.2 Introduction to CSS 3.3 Basic Syntax and structure 3.4 Inline styles 3.5 Embedding Style sheets 3.6 Linking External Style 3.7 Backgrounds 3.8 Manipulating Text 3.9 Margins and Padding 3.10 Positioning using CSS	12
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Learning Resources:

1. DT Editorial Services, “HTML 5 Black Book”, Dreamtech Press, 2010 3.
2. Kogent Learning Solutions Inc., “Web Technologies, Black Book”, Dreamtech Press, 2009
3. P.J. Deitel & H.M. Deitel, “Internet & World Wide Web How to Program (4th Edition)”, Pearson –Prentice Hall, 2000

F.Y B.Sc (Computer Science) – Semester II		
CSC -180	Basics of Scripting (VSC)	Credits : 02 Hours : 30
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Understand the JavaScript language & the Document Object Model.	
CO2	Develop the skill & knowledge of client-side programming.	
CO3	Validate data before sending out a request.	
CO4	Create web pages to work on objects and respond to events.	
CO5	Apply special effects to web pages.	
CO6	Creating cookies that can be used to store and retrieve information from the user's computer.	

Unit	Contents	No. of Hours
I	Fundamentals of JavaScript: 1.1 Introduction to JavaScript 1.2 Advantages and disadvantages of JavaScript 1.3 Client-side JavaScript 1.4 JavaScript development tools	03
II	JavaScript Basics: 2.1 Syntax 2.2 Variables 2.3 Operators 2.4 If-Else 2.5 Switch-case 2.6 Loop statements: While , for, for-in 2.7 Loop control: break, continue 2.8 Functions 2.9 Events	08

III	JavaScript Cookies: 3.1 What are Cookies? 3.2 How It Works? 3.3 Storing Cookies 3.4 Reading Cookies 3.5 Setting Cookies Expiry Date 3.6 Deleting a Cookie	04
IV	Interacting with user: 4.1 Alert Dialog Box 4.2 Confirmation Dialog Box 4.3 Prompt Dialog Box	03
V	JavaScript Objects and Methods: 5.1 Objects 5.2 Number 5.3 Boolean 5.4 String 5.5 Arrays 5.6 Date 5.7 Math 5.8 RegExp 5.9 DOM	08
VI	Form Validation: 6.1 Basic Form Validation 6.2 Data Format Validation	04

Learning Resources:

1. Programming JavaScript Applications: Robust Web Architecture with Node, HTML5, and Modern JS Libraries, O'Reilly, Eric Ebott
2. Tutorialspoint SimplyeasyLearning, "JavaScript Language"
3. www.w3schools.com
4. www.tutorialspoint.com

F.Y B.Sc (Computer Science) – Semester II		
CSC -190	Advance C Concepts (SEC)	Credits : 02 Hours : 30
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Define the basic concepts of C Programming to design more complex programs for solving problems.	
CO2	Illustrate the use of macros, structures and handling of files through C	
CO3	Implement various structure and file handling functions.	
CO4	Identify and organize data in structures and files to develop small applications.	
CO5	Test and validate the data stored in the structures and files and perform various operations on it.	
CO6	Design simple data processing applications for real-world problems. Develop the concepts for advanced programming like data structures and Object Oriented Programming	

Unit	Contents	No. of Hours
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I	C Preprocessor 1.1 Introduction of Preprocessor directive 1.2 File Inclusion directive 1.3 Macro substitution 1.4 Nested macro 1.5 Macro with arguments 1.6 Difference between functions and macros	04
II	Structures and Unions 2.1 Creating structures 2.2 Structure declaration and initialization 2.3 Accessing structure members (dot Operator) 2.4 Array of structures 2.5 Passing structures to functions 2.6 Nested structures 2.7 Pointers and structures 2.8 Self-referential structure 2.9 Unions: Declaration, Initialization and accessing 2.10 Difference between structures and unions 2.11 typedef	15
III	File Handling 3.1 Introduction – streams 3.2 Types of files 3.3 Modes of file opening 3.4 Operations on files 3.5 Random access to files	08
IV	Program Testing and Debugging 4.1 Types of Errors a. Syntax Errors b. Run Time errors c. Logical Errors 4.2 Common Programming Errors a. Missing and Misuse of semicolon b. Missing Brackets c. Missing AND Misuse of quotes d. Non declaration of function e. Missing & operator in scanf() 4.3 Debugging Tool: GDB(GNU Project Debugger)	03

Learning Resources:

1. E Balagurusamy: Programming in ANSI C, Fourth Edition, TMH
2. Behrouz A. Forouzan and Richard F. Gilberg: Computer Science: A Structured Programming Approach using C Third Edition, Thomson Course Technology publication
3. Yashavant Kanetkar: Let Us C, Seventh Edition, PBP Publications
4. Brian W. Kernighan and Dennis M. Ritchie: The C Programming Language, Second Edition, Prentice Hall Publication
5. Byron S Gottfried, Schaum's Outlines Programming With C, Second Edition, Tata McGraw Hill